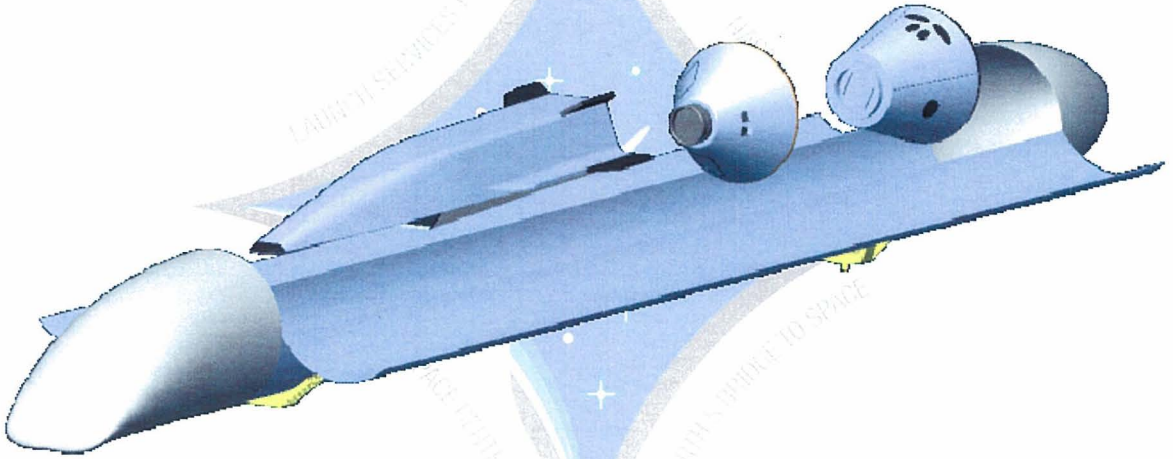
EXTERNAL PAYLOAD CARRIER (XPC)
A SUBORBITAL RESEARCH PLATFORM



Next-Generation Suborbital Researchers Conference

February 28, 2011

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NASA LAUNCH SERVICES PROGRAM

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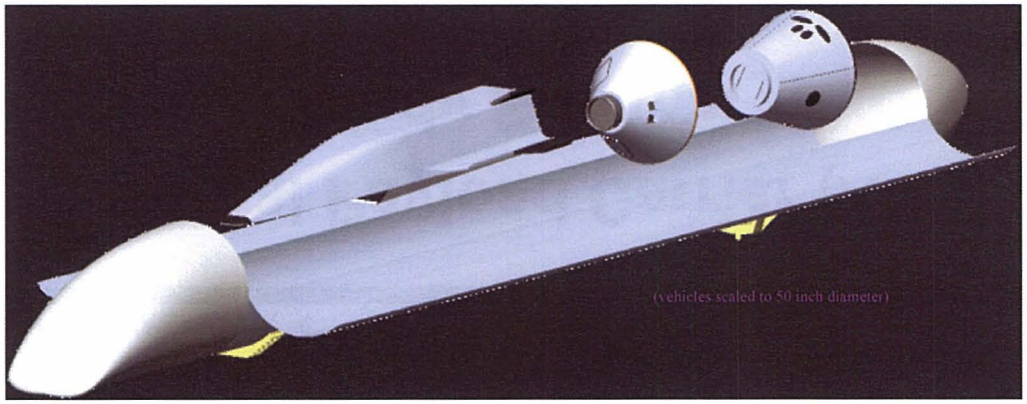
Presentation Overview

- External Payload Carrier (XPC) – Suborbital Heavy Lift
- Phase I Study Summary
- Phase II Results/Current Status
- Project Plan to First Flight
- XPC Points of Contact

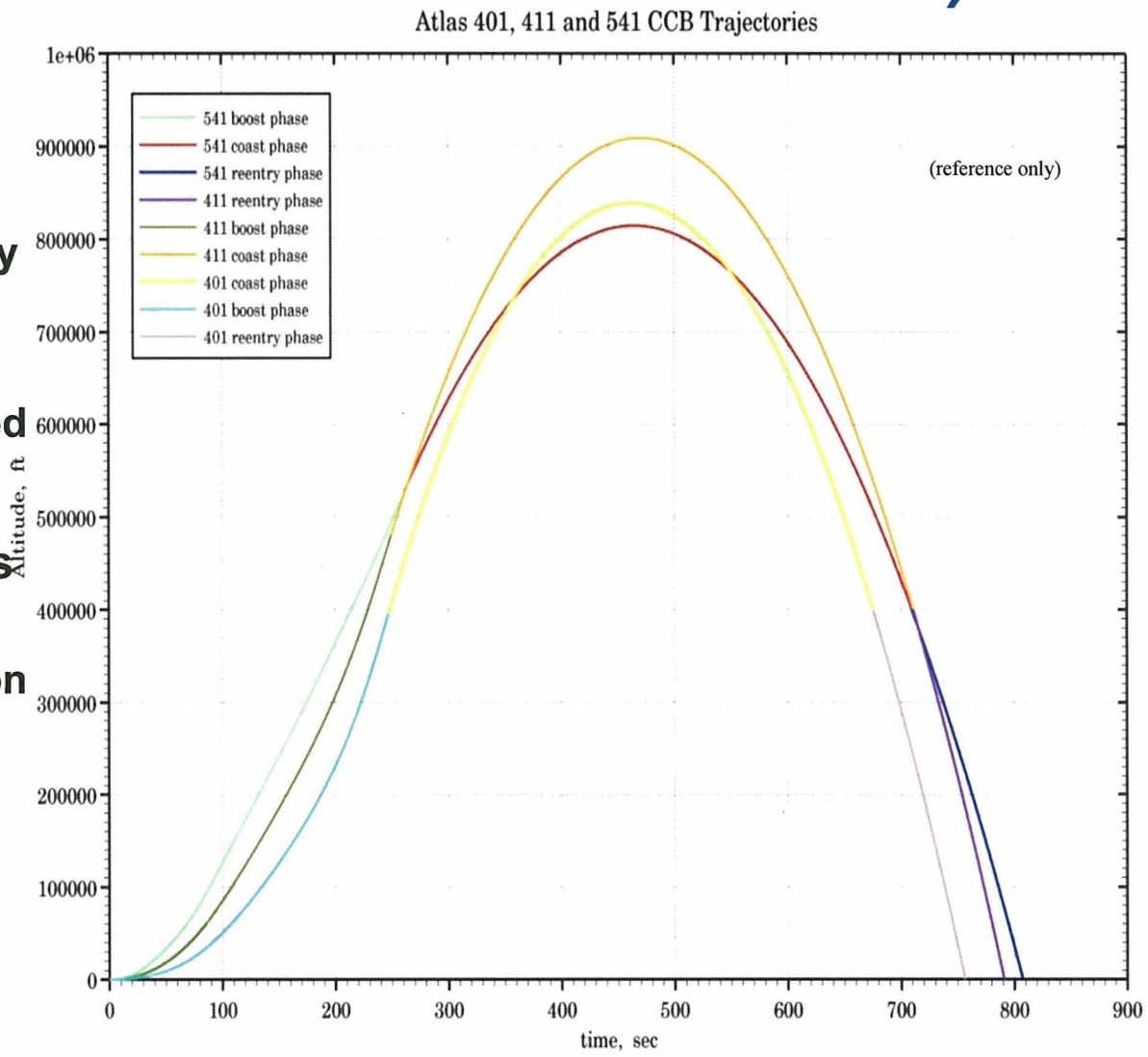
XPC Concept/Design

- "Suborbital Heavy Lift" on Atlas V Booster
- Flies in Unused SRB Location on Atlas V
- Anytime Sufficient Excess Performance is Available
- Jettisoned prior to Centaur separation
- Unpressurized
- Disposable
- Mimics Non-Propulsive SRB



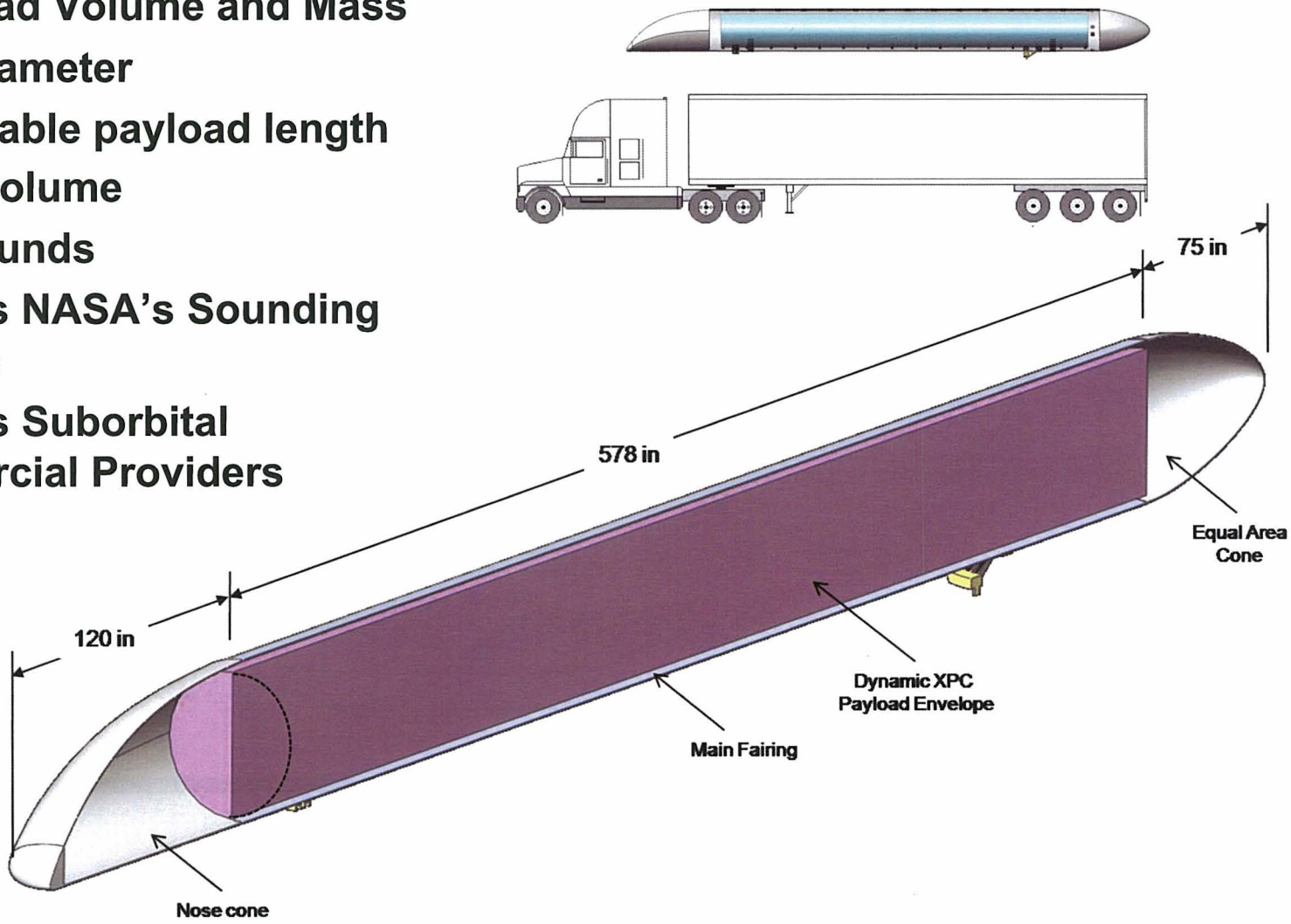
XPC Flight Regime

- **Large Payloads to High Altitudes**
  - **Suborbital to 800,000 ft**
  - **Up to 500 secs of μ-gravity**
  - **Possible from Excess Performance**
    - » **Result of Delta II-sized payloads on EELVs**
- **Jettisonable at Many Points on Stage 1 Trajectory**
  - **At nominal SRB separation**
  - **After SRB separation**
  - **As late as just prior to Centaur (2nd stage) separation**



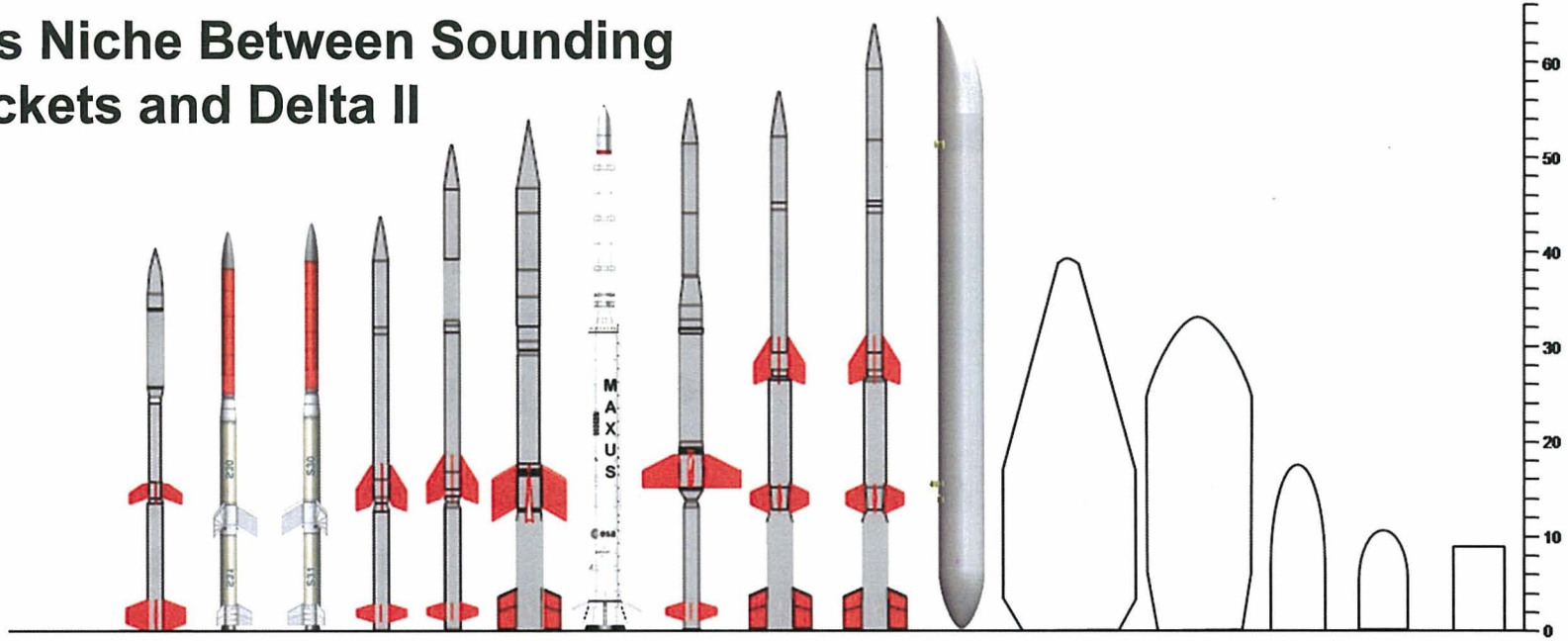
XPC Dimensions and Capability

- **Large Payload Volume and Mass**
  - **60 in. diameter**
  - **37 ft. usable payload length**
  - **800 ft³ volume**
  - **4000 pounds**
  - **Exceeds NASA's Sounding Rockets**
  - **Exceeds Suborbital Commercial Providers**



XPC Capability Comparison

- **Fills Niche Between Sounding Rockets and Delta II**



VEHICLE	Terrier Orion	Maser	Texus	Black Brant IX	Black Brant X	Talos Oriole	Maxus	Terrier-Oriole	Black Brant IX	Black Brant XII	External Payload Carrier (XPC)	Atlas V 4-m PLF	Delta II (-10L)	Falcon 1e	Pegasus	SpaceShip2
Payload Diameter (in)	17	17	17	17	17	30	25	22	17	17	50	148	108	54	45	66
Payload Length (in)	TBD	134	134	TBD	76	TBD	150	TBD	TBD	TBD	578	366	284	110	84	108
Payload Volume (ft^3)	TBD	18	18	TBD	10	TBD	43	TBD	TBD	TBD	1200	4200	2800	TBD	TBD	214
Payload Mass (lbs)	200	573	573	400	300	500	1058	800	400	250	5000	11000	4700	2300	460	2000
Maximum Apogee (nmi)	162	140	140	324	567	270	TBD	189	432	783	120	GTO	GTO	1600	756	60

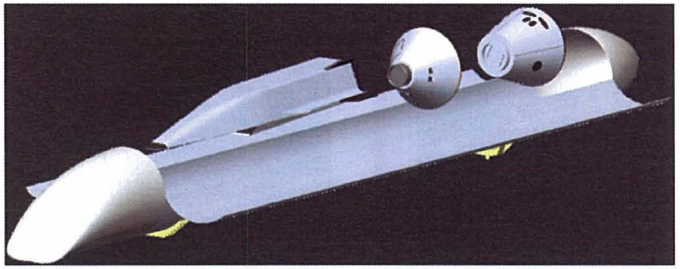
This package supports an oral presentation of the External Payload Carrier (XPC) for the 2011 Next-Generation Suborbital Researcher's Conference - 28 February 2011
This package to be used only in the context of the aforementioned Presentation

Promising Research Capability

- **Multiple User Interest**
  - NASA, DOD, DARPA, NRO, Academia, etc.
- **Does NOT Compete with Emerging Commercial Suborbital Market**
  - Limited flight rate
  - Involved integration process and approval by primary payload customer
- **Extremely Promising Test Bed**
  - Military and Commercial
  - High Altitude, Hypersonic Aeronautics
  - Microgravity
  - Tropospheric →Upper Atmospheric (Ionosphere) → Exoatmospheric Research
  - Reentry Vehicle Research
  - Reusable technology (EELV Next Generation)
  - Point to Point Applications

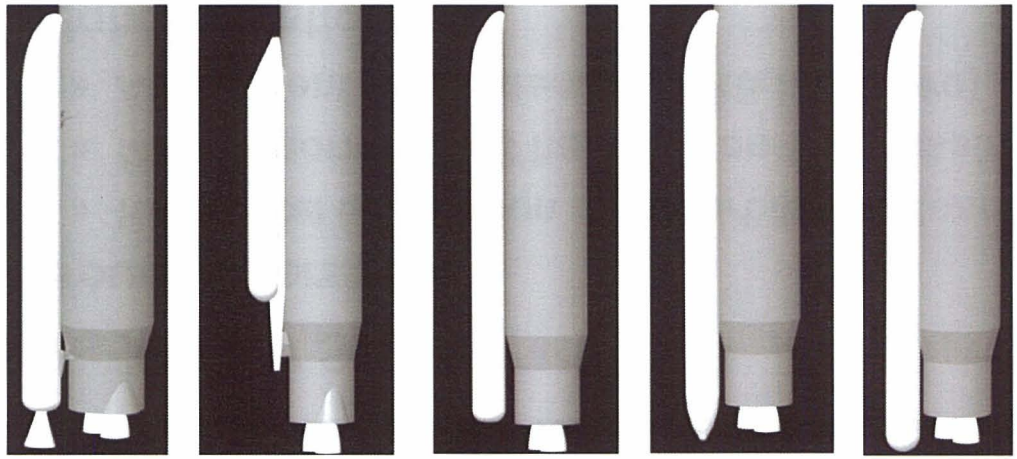
XPC - Operations Concept

- **Mimics Atlas V SRB**
  - **Ground Operations**
    - » **Horizontal integration of suborbital payloads**
    - » **Mimics normal SRB handling and processing**
    - » **Attachment (uses identical SRB hardware)**
  - **Flight Operations**
    - » **Aerodynamically equivalent to SRB**
    - » **Negligible impact to launch vehicle or primary payload**
    - » **Jettisonable at many points on Stage 1 trajectory**
      - **Atlas V qualified to carry expended SRB**

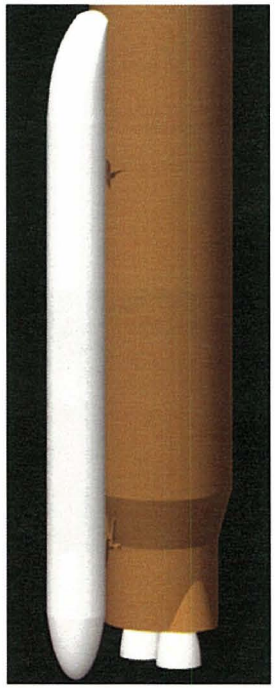


XPC Concept Early Studies
NASA LSP

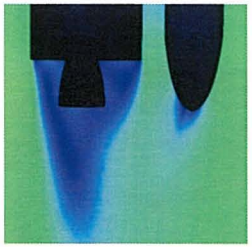
- **NASA LSP Internal (Preliminary) Studies**
  - **2008 and 2009**
  - **Aerodynamic Design Studies**
    - » **Multiple considerations**
    - » **Equal Surface Area Cone chosen**
    - » **Minimizes aero-thermal effect deviations**
    - » **Negligible affect on launch vehicle**



Atlas **411** | **POD** | Blunt **Base** | **Cone** | **Spherical Cap**

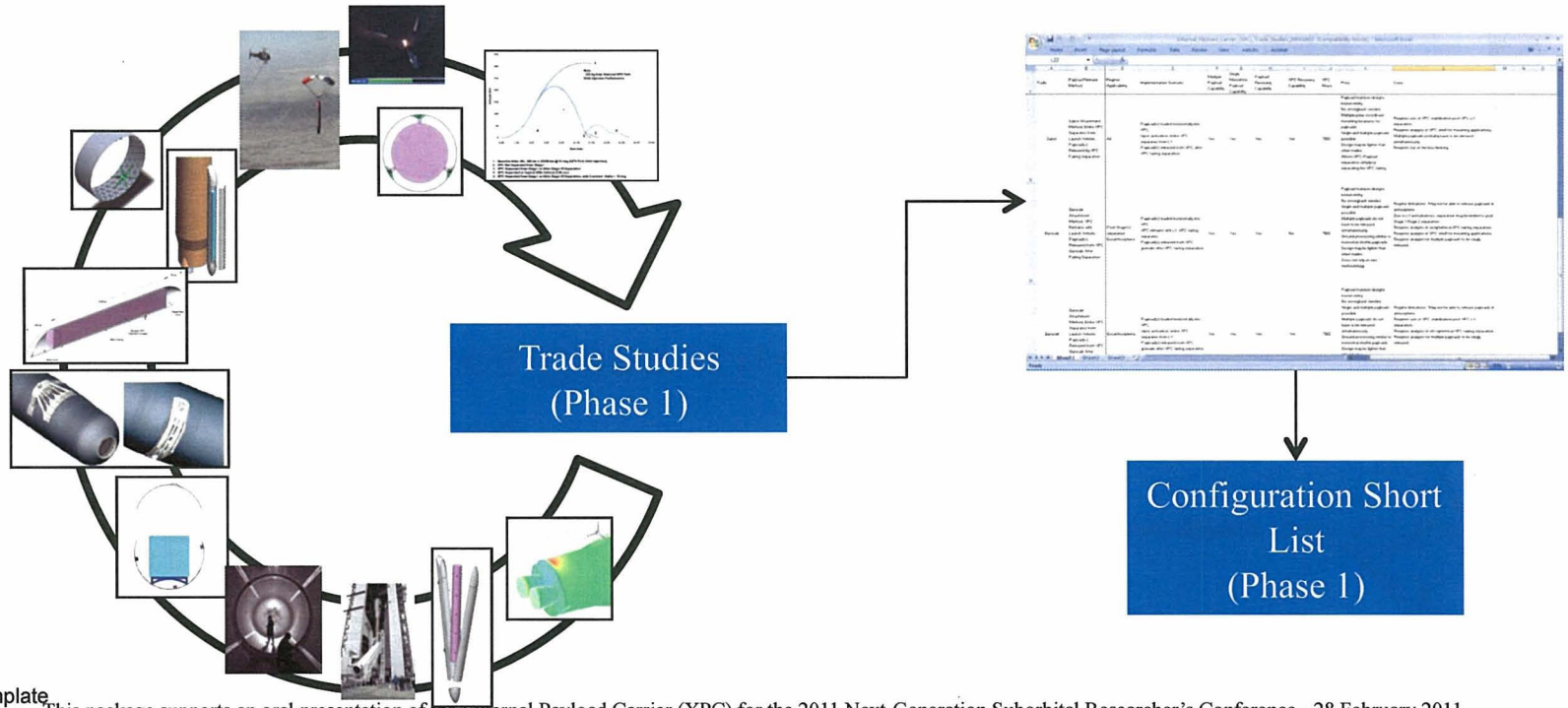


Equal Surface Area Cone



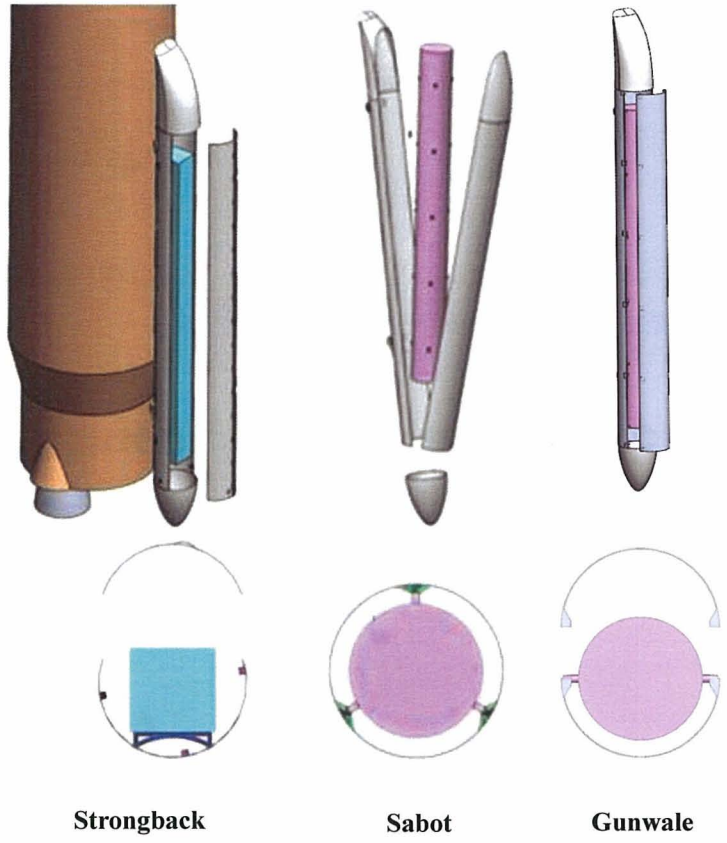
Phase I Study – Late 2009

- **ULA and SAS Tasked to Evaluate Feasibility**
  - **Funded by NASA LSP**
- **Research and Trade Studies Conducted**
- **57 Variations Considered**
  - **Configuration, Trajectory, Payload Attachment, Recoverability, etc**



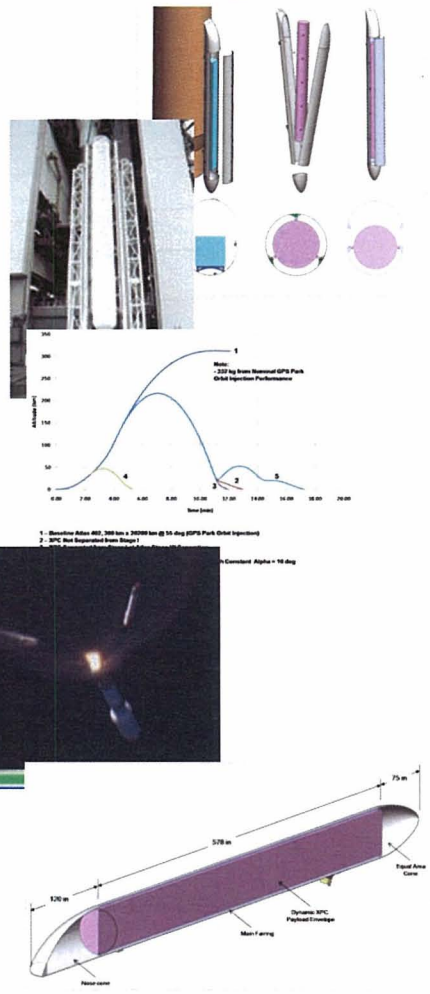
Phase I Study – Findings/Results

- Pros and Cons Identified
- Most Ground Operations Conducive
  - Minimal Additional Hardware
  - Same GSE and processes as SRB operations
- *All* Atmospheric/Exoatmospheric Regimes Attainable
  - Configuration Dependent
- Three Viable Configurations
  - Strongback
  - Sabot
  - Gunwale
- Configuration Options Identified →
  - Final configuration selection in Phase II-to-PDR effort



Phase I Study - Findings/Results (Con'd.)

- Design Baselines Identified
  - Aluminum isogrid (Revised to Al-composite structure/shell in Phase I)
  - SRB attachment hardware
  - SRB outer mold line
  - General flight capabilities
- Subsystems Identified
- Preliminary Testing Requirements Identified
- Preliminary Modeling Complete
- Draft System Requirements Document (SRD) begun
- Preliminary Feasibility Study Complete



Phase II - XPC to PDR Maturity Level

- **NASA LSP funded Phase II - Preliminary Design (PDR level) Effort**
  - **LSP funding and partnering support**
  - **Phase II nearing completion – March 2011**
- **Partnering Arrangements With:**
  - **Industry:**
    - » **Special Aerospace Services (SAS)**
    - » **United Launch Alliance (ULA)**
  - **Academia:**
    - » **Florida Institute of Technology (FIT)**
  - **USG:**
    - » **NASA Kennedy Space Center (KSC)**
    - » **NASA Marshall Space Flight Center (MSFC)**

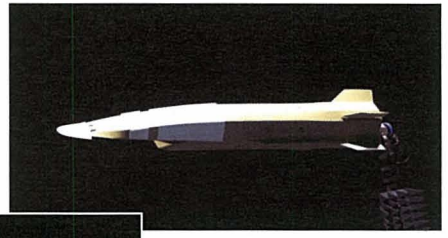
Phase II - Products/Deliverables

- **Phase II Products**
  - **Develop Systems Requirements Document (SRD)**
  - **Achieve Preliminary Design Review (PDR) level maturity**
  - **Presentation of XPC early design and systems requirements (SRD) to NASA LSP SRR/Engineering Review Board (ERB)**
    - » **November 2010**
- **Identify flight candidates for XPC**
- **Development schedule and funding profiles**
  - **Critical Design Review (CDR)**
  - **Design Certification Review (DCR)**
  - **First Flight**
  - **Recurring Cost**
- **Identify Risk-reduction Activities for Development**
- **XPC at TRL – 3 by end of Phase II**

Phase II – Current Status

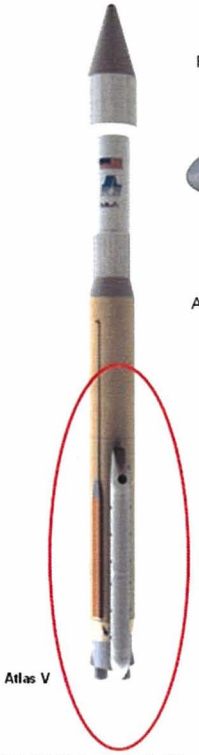
- **Phase II Results:**
  - XPC Final Configuration
  - Preliminary Payload Separation Design
  - Subsystem Preliminary Designs
  - Concept of Operations and launch site processing approach developed

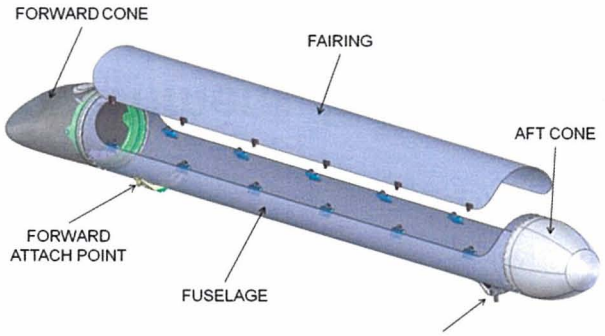
- **Seeking additional input and funding from user community**
  - NASA Mission Directorates
  - DoD, DARPA, NRO
  - Commercial Sector



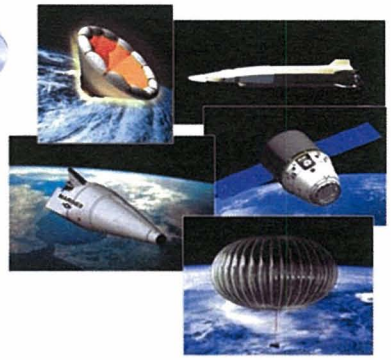
XPC Project Milestones to First Flight

- **Completion of Preliminary Design (4th Qtr 2011)**
- **Completion of Critical Design (4th Qtr 2012)**
- **Constructing, Testing, and Qualifying Activities (2013)**
- **First Flight (2013 or 2014)**





- *Military*
- *Commercial*
- *High Altitude, Hypersonic Aeronautics*
- *Microgravity*
- *Atmospheric -Exoatmospheric Research*
- *Reentry Vehicle Research*
- *Reusable technology (EELV Next Generation)*
- *Point to Point Applications*



SUBORBITAL HEAVY LIFT

Summary

- External Payload Carrier (XPC)
- Suborbital Heavy Lift
- 800 cubic feet
- 4000 pounds
- Team includes Government, Industry, Academia
- First Flight Goal – 2013

JOHN F. KENNEDY SPACE CENTER

XPC Points of Contact (POCs)

LAUNCH SERVICES PROGRAM

- **NASA Launch Service Program**
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- **Special Aerospace Services (SAS)**
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